REMARKS

This is in full and timely response to the above-identified Office Action. The above listing of the claims replaces all prior versions, and listings, of claims in the application. Reexamination and reconsideration in light of the proposed amendments and the following remarks are respectfully requested.

Technical Problem

In the prior art calibration processes as set forth in paragraphs [0002] – [0014] of the present specification, there are defects in positioning between the print media, the pen, and the carriage which carries the pen.

Calibration consists of measuring an angle theta zeta by printing a set of patterns onto a print media, scanning them, using a scanner device, and applying an algorithm to compare the actual geometry of the pattern with a theoretical geometry of the pattern.

Ink jet nozzles print on a nominally vertical straight line and an object of calibration is to make a straight line vertical with respect to the print media. The angle between a nominally vertical line printed by the pen on the media and the main vertical axis of the paper needs to be measured.

Each group of nozzles prints a line of squares. The pattern is then scanned in line by line. By locating all the squares produced by a pen, the angle of the pen relative to the paper axis can be calculated.

A problem with this known technique is that a skew in the paper may be introduced when the media advances between consecutive scans of the pen across the print media.

In a printer device in which the pens and carriage are perfectly aligned relative to the media transport mechanism, the image can still be slightly skewed relative to the print media, due to the mis-alignment of the print media within the media transport mechanism.

The algorithm actually measures the angle between a nominal vertical line of an image as printed by the pen, and the movement performed by the media during a scan phase. To properly determine the angle of mis-alignment, theta zeta, there also needs to be determined how many degrees of the angle are due to the skew of the print media, and how many degrees are due to the defect which is to be corrected. Therefore, the amount of skew needs to be measured.

The "skew angle" is the angle between a main length axis of the print media sheet, and a main length axis of the image printed on the print media sheet. Once the skew angle is determined, this can be used to refine the evaluation of the angle of mis-alignment, theta zeta.

Therefore, to summarize:

Theta zeta = skew angle + defect angle.
Theta zeta = total angle of mis-alignment.
Skew angle = angle between main length of print media and main length of image on the print media.
Defect angle = the angle due to the defect.

In the prior art method of skew angle determination [0013] a pattern of squares is printed. The mean position of each row of squares is evaluated and a best fit line passing between the mean position of each row of squares is determined, giving an upright line. The angle between the upright line and a true vertical line is taken as the skew angle.

However, correction performance is lowered because the skew angle is only roughly approximated by this best fit technique ([0014] – Fig. 4 present application).

Problem addressed by Present Application

In the prior art disclosure, there were made basic assumptions that:

(a) The print media moved on a constant axis of movement, which does not vary during the movement of the print media through a print mechanism.

(b) The axis of movement did not move between one movement of the print media and another.

However, inventors have realised that the above assumptions are too simplistic and are wrong in practise. In fact, a combination of various mechanical issues are present which affect the automatic alignment process, including:

[0039] skew between the print media and the print mechanism

[0040] variation of skew angle for different media types on the same printer device

[0041] variations of skew angle occur for different media sizes on the same printer device

[0042] variations of skew angle occur for the same media item when placed on different printer devices due to variations between individual printer devices

[0043] separation of the scan operation and the print movement leads to a wide amplitude displacement of the print media

[0044] the print media is pulled back through the printer before a scan operation commences. The print media may be taken off the printer device, be duplexed, or have other operations performed on it before the scan process occurs.

Specific embodiments of the present disclosure address a problem where the print media may be removed from a printer device between printing of a test pattern and performing a scan operation.

Present embodiments

In the present embodiments, an optical sensor is provided in the casing of the carriage [0046]. That is, the optical sensor is fixed relative to the print head.

An algorithm performs automatic alignment to the print heads [0050] as follows:

- a set of markings are printed on the media and scanned in (by the scanner positioned on the print head)

- an angle of mis-alignment is determined between the print head relative to the media transport mechanism, from the scanner reading

- corrections to a data stream of print data are made so that a printed image on the media is printed in correct alignment to the media. The correction to the data is made from the information of the angle of mis-alignment between the print head relative to the media transport mechanism.

The two dimensional peak values of each signal spike are determined (see 1703, 1704) and a linear regression is calculated from the two dimensional positions of the peaks [0073 – 0077], [0078].

Claim Amendments

In this response, independent claims 1, 10 and 14 have been amended to clarify that it is skew of the print media sheet which is being determined. Claim 12, without amendment already made this feature clear. Inasmuch as the King et al. reference is devoid of the term "skew" it is submitted that all of the independent claims pending in this application clarify over the cited reference.

Support for the amendments is found in the specification taken as a whole. Support for the two-dimensional limitation can be found on page 15, line 24; page 16, line 12, and page 17, line 4, merely by way of example.

Rejection under 35 USC § 102

The rejection of claims 1-14 under 35 USC § 102(e) as being anticipated by King et al. is respectfully traversed.

King et al. disclose a method for determining vertical mis-alignment between print heads. This is a different problem to that addressed by the present application.

In the King et al. reference there is only addressed one of the variables which can cause miss alignment in a printer device, that of vertical mis-alignment between two or more print heads, and under conditions where the horizontal mis-alignment is already known (see column 1 lines 8 – 35, King).

In the King et al. reference no use is made of the two dimensional information of the peaks of signal. That is, no use is made of the information of heights of signal peak relative to each other. The signal peaks are treated as one dimensional information.

In the method disclosed in the King et al. reference, a test pattern using slanted blocks extending horizontally across a media needs to be used. In contrast, in the present application it is not necessary to print slanted blocks. A variety of shapes may be used in the print pattern in the present embodiments. The disclosure makes reference to rectangular blocks for example.

King et al. do not determine the angle of mis-alignment of a printer head relative to a media transport mechanism, i.e. it does not determine the skew angle.

Conclusion

In view of the amendments and the preceding arguments, the applicant respectfully requests favorable reconsideration and allowance of this application.

Respectfully submitted,

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By _____

HEWLETT-PACKARD COMPANY
Customer No.: 022879

William T. Ellis
Registration No. 26,874

Keith J. Townsend
Registration No. 40,358